the original SARS spike protein into the spike protein from a bat virus, we should see this. Specifically, when we examine the amino-acid sequence of the SARS-CoV-2 spike protein, we should see pieces that match the SARS-CoV-1 spike protein, with the rest matching the bat spike protein.

As Figure 1.1 shows, we see nothing of the sort. There are only three extended regions where the new coronavirus (SARS-CoV-2) spike protein differs from the most similar bat virus spike protein. Even in these regions, the SARS-CoV-2 protein is more like the bat virus protein than the SARS-CoV-1 spike protein. At the six key places for grabbing the appendages on human cells,[14] the SARS-CoV-2 spike protein is equally unlike the spike proteins from SARS-CoV-1 and the bat coronavirus (one

Spike protein region 1:

```
SARS-CoV-1:  TRNIDATSTGNYNYKYRY
SARS-CoV-2:  SNNLDSKVGGNYNYLYRL
   Bat CoV:  SKHIDAKEGGNFNYLYRL
```

Spike protein region 2:

```
SARS-CoV-1:  GKPCTP-PALNCYWPLNDYGFYTTTGIGYQ
SARS-CoV-2:  STPCNGVEGFNCYFPLQSYGFQPTNGVGYQ
   Bat CoV:  SKPCNGQTGLNCYYPLYRYGFYPTDGVGHQ
```

Spike protein region 3:

```
SARS-CoV-1:  L----LR
SARS-CoV-2:  NSPRRAR
   Bat CoV:  NS----R
```

Figure 1.1. Full spike protein sequences for SARS-CoV-1,[15] SARS-CoV-2[16], and bat coronavirus RaTG13[17] were aligned using Clustal Omega.[18] Amino acids are represented by conventional, 1-letter abbreviations.[19] Using position numbering for SARS-CoV-2, region 1 runs from 438 to 455; region 2 runs from 477 to 506; region 3 runs from 679 to 685. Dots indicate matching amino acids. The SARS-CoV-1 sequence is greyed except where there is a match between the two SARS sequences and a mismatch between SARS-CoV-2 and the bat coronavirus. Boxes show positions known to be important for infecting human cells.

We all saw graphs illustrating the need to "flatten the curve." Vox produced the most viral version, which Barack Obama tweeted to his 117 million followers.[19] It looked something like this:

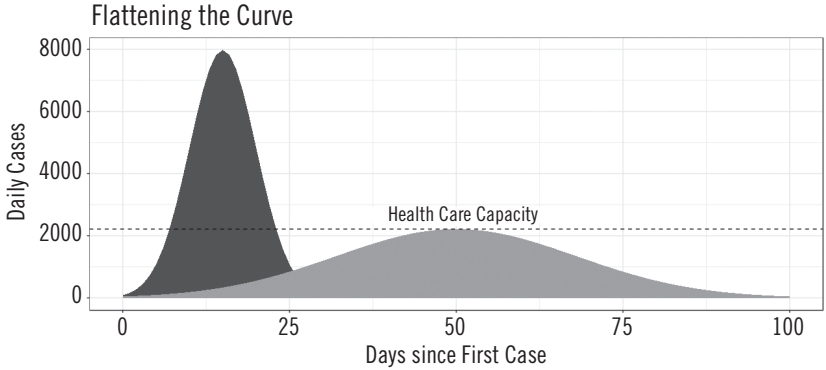


Figure 2.1. Graphs like this were used to educate the public on the meaning of "flatten the curve."

There are two curves: a high-peaked one and a flattened one. The high-peak curve represents predicted daily cases of COVID-19 without protective measures; the flat one, with protective measures. Channeling their favored experts, the media said we must avoid the high peak and aim instead for the flattened one. Why? To prevent hospitals from being overwhelmed by sick patients in the early weeks by staying below the dashed line. The idea wasn't to reduce the total number of cases, but rather to ensure proper care of the inevitable severe cases. "A flatter curve," as an article at Live Science explained, "assumes the same number of people ultimately get infected, but over a longer period of time."[20]

It's a compelling image, but it's also far too simple. We should not compress healthcare capacity into a single number. In the real world, there are ER doctors, ICU doctors, different kinds of nurses, and other personnel. There are ventilators and many other kinds of equipment. There are medical supplies of every kind. There are ER beds and ICU beds and general hospital beds, beds for general surgery and post-surgery recovery rooms. There are differences between regions. The list goes on

of a man who had said, "I'm not worried about this thing" and then died of it a week later. Public mood shifts to the opinion that scoffers like that have it coming. New deaths in the United States break one hundred a day, then more than two hundred a day—*each and every day.*

Panic and fear are everywhere. In the worst week, 1,626 deaths are recorded. The news is all virus, all the time.

Then, just as politicians are ready to issue shelter-in-place orders, deaths fall to 1,179 a week, a clear decrease. The order is delayed. Predictions of a second spike, based on a computer model, go viral. The pitch of the panic is still feverish.

Yet the drop proves real. For the first time in two months, a week passes with fewer than 1,000 deaths. The next week it's down to 738. Then only 500.

"We're not out of it yet!" warn the nation's top experts. The *L.A. Times* runs a story under the headline: "Californians are losing their fear of the virus, setting the stage for disaster." But even as they broadcast their fear, the weekly deaths drop below one hundred to fifty-three. Then forty-three. Then twenty-six.

The following week we all forget the virus and return to other outrages *du jour.* Until next year, when the cycle repeats. As it would every year if we gave a blow-by-blow account of the seasonal flu in the United States.

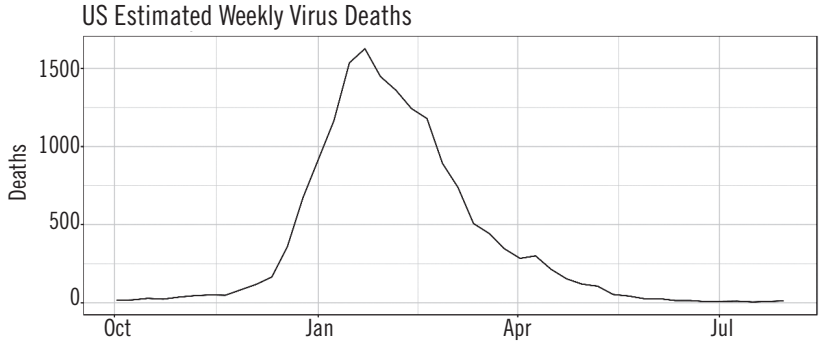


Figure 3.1. The CDC's estimated weekly flu deaths in the United States in the 2017–2018 flu season.

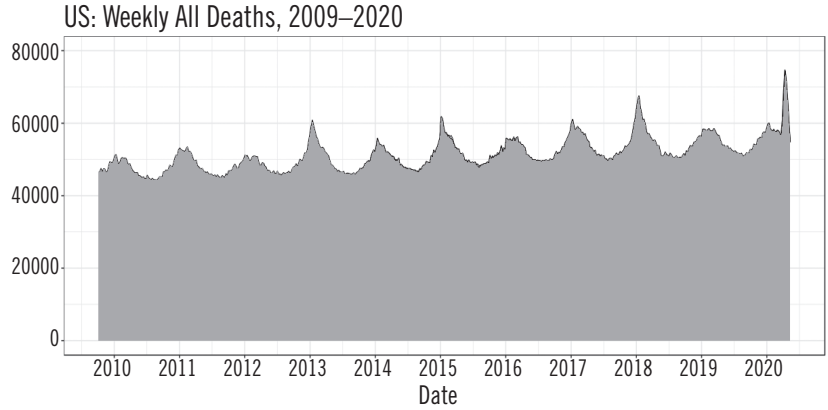


Figure 3.2. Weekly U.S. deaths by all causes (CDC). This plot is produced from three separate official CDC sources.[16] One runs from 2009 until 2019; the second begins in 2014 and continues until week twenty of 2020; and third starts at 2020 and includes COVID deaths.

Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK (England), UK (Northern Ireland), UK (Scotland), UK (Wales). In the striped bar on the far right, instead of actual data, there is an estimate to compensate for delays in reporting.

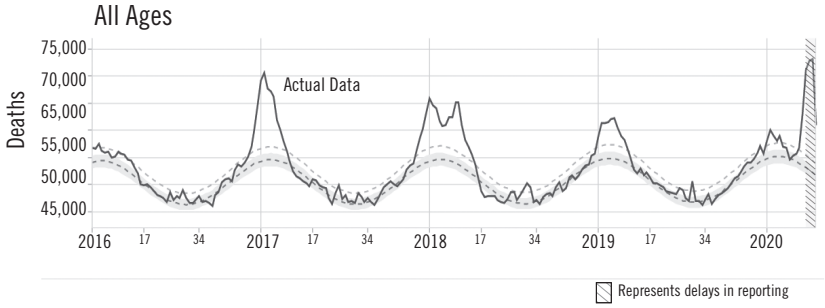


Figure 3.3. Weekly deaths by all causes in the European countries listed in the text (solid line), along with mathematical models that attempt to capture the overall trend (dashed lines).

Figure 3.3 shows two dashed lines representing two aspects of a statistical model, which you can see smooths the data. For now, don't

worry about the differences between those lines. Just notice the difference between the actual data (solid line) and the smoothed trends (dashed lines). It's easy to see how the peaks each winter stick out above the waves. Those peaks sticking out above the dashed curves represent what are called "excess deaths." These excess deaths every flu season, which can be attributed to the flu, are summed for each annual flu season to get the estimated number of flu deaths for that year.

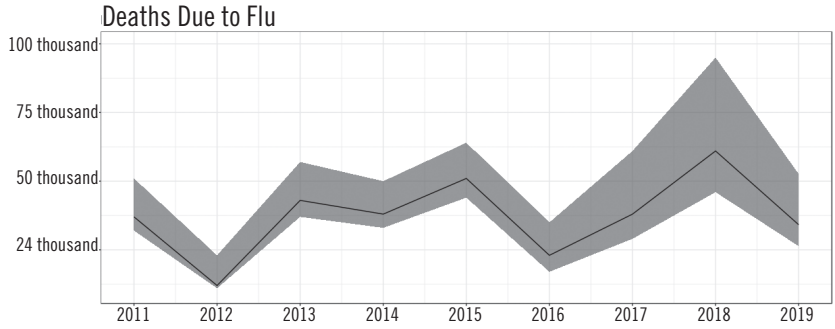


Figure 3.4. Estimated annual excess deaths by season from influenza in the U.S. (2011–2019). Years indicate year when flu season ends.

Figure 3.4 shows how the estimated flu deaths vary from year to year as a black line, with "confidence" bounds shown in gray.[17] (The number for the 2019–20 season had not been reported when this book went to press, but the CDC prediction is about twenty-four thousand deaths.)

Until recently, this complicated method for estimating flu deaths didn't receive much public scrutiny—because people usually don't panic over the flu. Before 2020, had you ever even wondered how many people died of the flu every year? Be honest.

The plot in Figure 3.4 is yearly, so it's peaky and spikey on one-year intervals. But you could also graph weekly data. That line would be much smoother over the course of a year. Alas, this difference led some otherwise serious writers to make serious blunders during the crisis. And it was inevitable that hyper-partisan, fear-mongering reporters would bungle the details.

Indeed, even the calmer, more objective media made mistakes. "Not Like the Flu, Not Like Car Crashes, Not Like…" was the title of an article written by three editors of the *New Atlantis*. You can get the gist of it from their chart for the United States (they did a similar one for New York, which has the same problems). The *New Atlantis* is a fine publication that often challenges conventional wisdom. But in this case the editors made a big mistake.

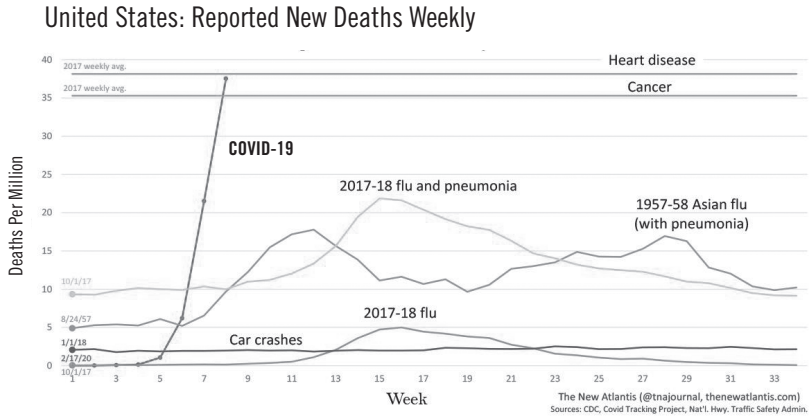


Figure 3.5.

Actual counts of reported coronavirus deaths by week are represented by the steep line labeled "COVID-19." In contrast, heart disease and cancer deaths are shown on top as estimates from averages. Car crash estimates are at the bottom, and flu estimates for some previous years are in the middle.

The *New Atlantis* editors said, "It's about the spike."[18] It sure is. But not in the way they say. No one should compare that spike with smoothed estimates, as the authors did, since it misleads.

Let's assume those coronavirus death counts are accurate (as we've seen, they're likely exaggerated). The editors were still comparing actual data (for coronavirus deaths) with smooth estimates derived from models (for the flu). And smoothed estimates from models will always make

defended the elevated figures on the grounds of delayed official recording by the CDC. According to the CDC, their numbers "provide the most complete and accurate picture of lives lost to COVID-19."[10]

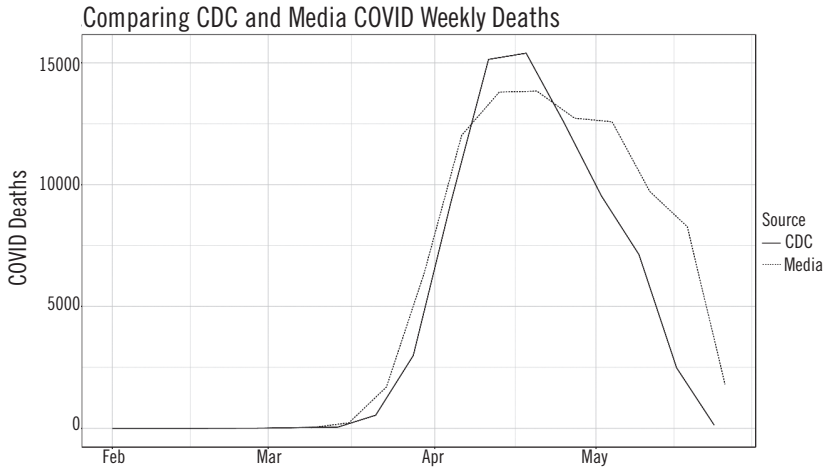


Figure 6.1. Comparison of weekly COVID-19 death counts from the CDC (Death Counts for Coronavirus Disease: https://www.cdc.gov/nchs/nvss/vsrr/covid19/index.htm) and the COVID Tracking Project (associated with *The Atlantic*; https://covidtracking.com), through May 26, 2020.

In the UK, pathology professor John Lee explained that his country had not previously recorded the pathogens leading to death by respiratory failure (a common cause of death) on death certificates "unless the illness is a rare 'notifiable disease.'"[11] Until recently, the list of those special diseases excluded common seasonal viruses, such as the flu and previous coronaviruses. Instead, it included the really scary pathogens—anthrax, the plague, and so forth.

Adding COVID-19 to this list was a self-fulfilling prophecy: it inflated the count of COVID-19 deaths. As Dr. Lee put it, "Making COVID-19 notifiable might give the appearance of it causing increasing numbers of deaths, whether this is true or not." By the new rules, whatever the true cause of death, once a patient tests positive, hospital staff "*have* to record the COVID-19 designation on the death certificate—contrary to usual

much like the usual victims of pneumonia: elderly and sickly. That's why the coronavirus hit nursing homes so hard.[23]

The CDC reported an average of 2.5 *non*-COVID conditions listed on the certificates for deaths attributed to the coronavirus.[24] In fact, COVID-19 was the sole cause listed for *only 7 percent* of these deaths. More perplexingly, "intentional and unintentional injury, poisoning and other adverse events" were listed as a causes for several thousand deaths attributed to COVID-19. That's a small fraction of the total, but it shows a systematic problem with how data were handled during the pandemic. The CDC does strive for accuracy in the long run, but it takes time to deliver that. When the press is clamoring for bad-news headlines on an hourly basis, they're bound to get frustrated with the lengthy process of finalizing the data on deaths. So, they cut corners and put out half-baked numbers in a hurry.

Figure 6.2 shows how the highly imperfect counts of coronavirus deaths in 2020[25] compare to pneumonia deaths in 2018 and total deaths in 2018 in several states.[26] In only three of them—New York, New Jersey,

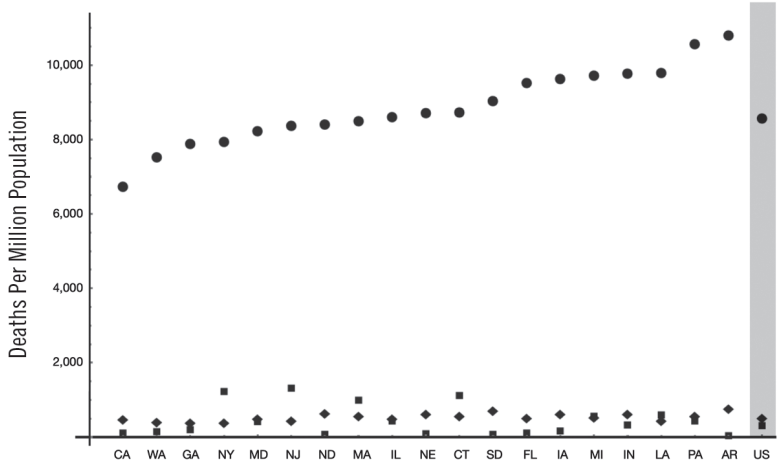


Figure 6.2. Comparison of COVID-19-attributed deaths in various states in 2020 (squares) to 2018 figures for total deaths (circles) and pneumonia deaths (diamonds). COVID-19 death counts are accurate as of May 31, 2020. Data source: https://covidtracking.com/data.

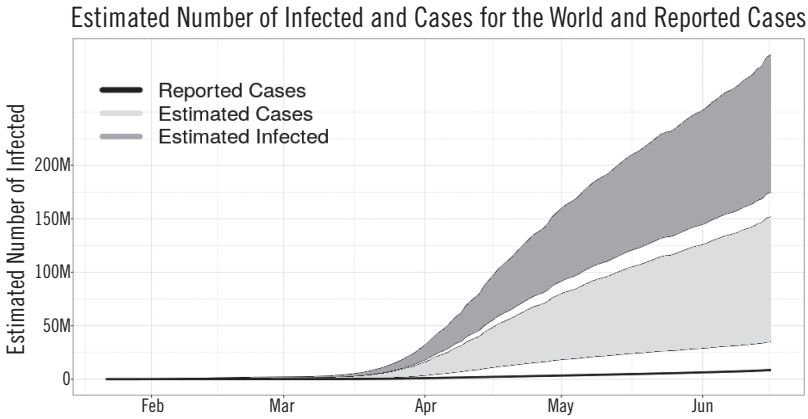


Figure 6.3. Total reported COVID-19 cases globally by date, compared to the estimated total number of cases and infections. The estimates are derived using actual infection and case rates given by the CDC and other sources. This shows that the reported cases do not come close to measuring the true extent of the spread of the coronavirus.

bottom shows total reported cases worldwide, which we know must be too low if the estimated case-fatality rates are anywhere near the mark. The lighter grey envelope estimates the total number of actual cases (given the 0.3 percent to 1.3 percent range for case-fatality rates). There are far more actual cases than reported cases—anywhere from 5 to 21 times as many. The total number of actual cases by May 27 was anywhere from 25 to 120 million people. That is, about 0.3 percent to 1.6 percent of the world's population had experienced symptoms or were otherwise cases by that date.

The dark grey envelope shows the estimated total number of infected people worldwide, by date, using the estimated infection-fatality rates of 0.15 percent to 0.26 percent. The 0.15 percent (highest line) IFR gives the largest estimate of total infections. This makes sense, since for a given number of deaths, more infections drive infection-fatality rates lower. The estimated number of infected people is 25 to 43 times higher than the reported cases. This will matter when we consider what the media did with

reported cases. We estimate the number of actual infections by May 27 to have been between 140 and 240 million people. That is, about 1.8 percent to 3 percent of the world's population had been infected by that date.

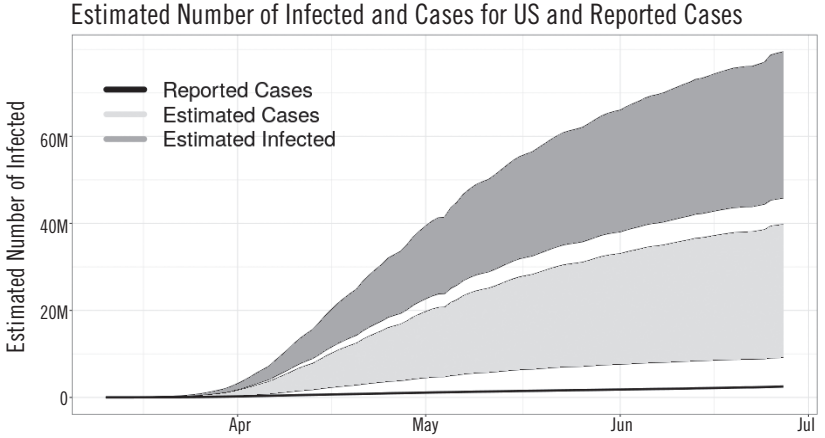


Figure 6.4. Total reported COVID-19 cases in the U.S. by date, compared to the estimated actual total number of cases and infections. The estimates are derived using estimated actual infection and case rates given by the CDC and other sources. This shows the reported cases do not come close to measuring the true extent of the spread of the coronavirus.

Figure 6.4 makes the same comparison for the United States. As before, the bottom dark line shows the total reported cases. The lighter gray envelope represents estimates of total cases assuming 0.3 to 1.3 percent CFRs. Again, we estimate the actual total cases to be about 5 to 19 times higher than the reported cases. The total number of actual cases by May 27 was anywhere from 8 to 30 million Americans. That is, about 2.4 percent to 9.1 percent of the U.S. population had experienced symptoms or were otherwise cases by that date.

The darker gray envelope represents estimates of total infected people, assuming 0.15 to 0.26 percent IFRs. So, the number of infected would have been about *twenty-two to thirty-eight times higher* than the reported case numbers. The number of actual infections would have been

the infection curves. This would also spread out the death curves. We'll take a critical look at whether they worked in chapter 9. In any case, the virus had largely run its deadly course by the end of June.

Forest fires often follow a similar trajectory. They spread fast when a dry-wooded region is mostly unburned, but at some point they run out of trees. At that point, an honest press would report that the fire is contained and largely out. Of course, reporters could find little pockets of fire and set up their cameras there for a while. That's what the media did with COVID-19. Well into July, they tried to keep the COVID flames burning by chasing case numbers.

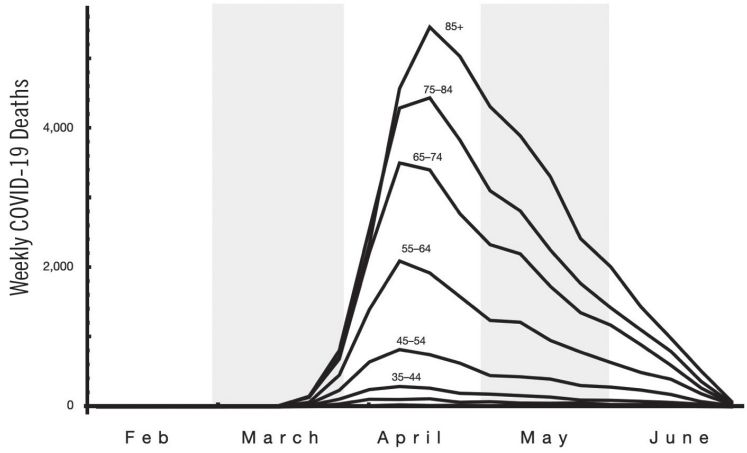


Figure 6.5. Weekly deaths attributed to COVID-19 in the U.S., as reported by the CDC through the week ending June 27, 2020. Labels show age ranges for the upper six curves. The curve for deaths at 25–34 years of age is visible below the one for 35–44. Deaths among people under 25 are plotted in a single curve, with numbers too small to be seen here.

On May 20, according to Worldometer, the globally reported COVID-19 deaths were 329,732, and the reported cases were 5,090,064. What we're calling the case-fatality rate, then, was 6.5 percent. The reported deaths in the United States, according to the Covid Tracking Project, were 87,472, and reported cases were 1,542,309. Using those

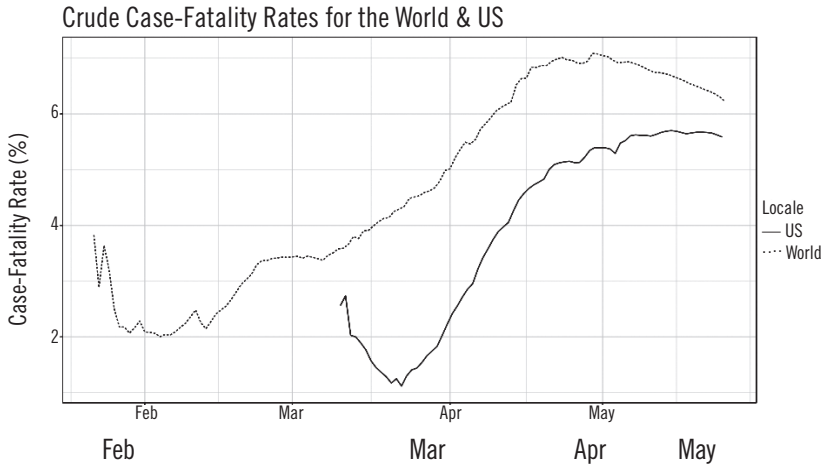


Figure 6.6. Daily estimates of crude COVID-19 case-fatality rates for the world and the United States, through May 21.

numbers, the case-fatality rate was 5.7 percent. Which is right, 6.5 percent or 5.7 percent?

Neither. Figure 6.6 shows how estimates of these case fatality rates varied from day to day for the world and for the U.S. as the pandemic ran its course. If there's really one true rate, then most of the daily estimates are wrong. In fact, they could *all* be wrong. This is why we've stressed that they are based on reported cases and deaths, and not actual cases and deaths.

If reported deaths are too high—for example, if many who died *with* and not *from* the virus were classified as COVID deaths—then the case-fatality rate will also be too high. Undercounting or under-reporting the actual cases would also make the rate too high. Both errors were probably occurring.

More relevant than the case-fatality rate is the infection-fatality rate. This is the number that might tell you how likely death is if you catch the virus—sort of. The two are quite different, though the press didn't always make the distinction. The coronavirus wasn't killing 5 to 7 percent of the people it infected in early May, as a naive reading of these figures might suggest. The limited testing wasn't revealing all

century, we may have rather crude estimates. Estimated deaths from the Spanish flu, for example, range from seventeen to almost sixty million.[38] Still, it makes sense to compare these events, especially the ones in the last few centuries, to the current pandemic.

In Table 6.5 we've put together the information for eighteen historically significant plagues, epidemics, and pandemics. The numbers for these in modern times are pretty accurate. The further back we go in time, the less certain they are. We only show events where the total number of deaths was reported to be at least a hundred thousand.[39]

Event	Date	World Deaths	Percent
Plague of Athens	429–426 BC	75–100 thousand	0.8
Antonine Plague	165–180 AD	5–10 million	3
Plague of Cyprian	258 AD	1 million	0.4
Plague of Justinian	541–542 AD	25–100 million	21
Japanese smallpox	735–737 AD	2 million	0.6
Black Death	1331–1353	75–100 million	21
Mexico smallpox epidemic	1520	5–8 million	1.4
Cocoliztli epidemic	1545–1548	5–15 million	0.2
Cocoliztli epidemic	1576–1580	2–2.5 million	0.4
Italian plague	1629–1631	280 thousand	0.05
Great Plague of London	1665–1666	100 thousand	0.02
Great Plague of Marseille	1720–1722	100 thousand	0.007
Persian Plague	1772	2 million	0.2
First cholera pandemic	1816–1826	100 thousand	0.009
Second cholera pandemic	1829–1851	100 thousand	0.008
Third cholera pandemic	1852–1860	1 million	0.008
Flu pandemic	1889–1890	1 million	0.06

Table 6.1. The percent killed worldwide for various diseases with death tolls of at least 100,000, up to the beginning of the twentieth century. World population figures for the percent calculation are from Wikipedia.[40]

Percent Worldwide	Deaths	Date	Event
0.007*	> 12 million	1855–1960	Bubonic plague pandemic
0.0002*	> 800 thousand	1899–1923	Sixth cholera pandemic
0.008*	1.5 million	1915–1926	Encephalitis lethargica pandemic
3	17–100 million	1918–1920	Spanish flu
0.07	2 million	1957–1958	Asian flu
0.3*	500 million	1877–1977	Smallpox
0.03	1 million	1968–1969	Hong Kong flu
0.02*	> 32 million	1920–Present	HIV/AIDS pandemic
0.009	152–575 thousand	2009–2010	Swine flu
0.004	400 thousand	2019–June, 2020	COVID-19

Table 6.2. Epidemics and pandemics with at least 100,000 dead since the beginning of the twentieth century. The percentages with asterisks are rough averages per year, as these represent events that occurred over multi-year spans. For example, smallpox killed an average of about 0.3 percent of all people per year from 1877 to 1977.

0.02 percent per year. The bubonic plague, caused by the same bacteria as the earlier Black Death, also ranged over a century: it began in 1855 and lasted until 1960, killing about twelve million people, mostly in India and China.

The other events were more localized in time. The Spanish flu is the most infamous, having killed anywhere from 17 to 58 million, with some estimates as high as 100 million. If the 58 million number is right, then that influenza outbreak killed 3 percent of the roughly 2 billion people alive. This would be 231 million in today's numbers!

Among the more recent influenza outbreaks, the Asian flu (1957–1958) killed about two million people, or 0.07 percent of the world population. There was no worldwide panic. The Hong Kong flu, in the 1968–1969 season, killed about 1 million people, or 0.03 percent of the population. Again, no worldwide panic.

SARS was a media event in 2002–2004, especially in Asia. There was widespread worry at the time, expressed by both official and unofficial

sources, that this disease might cause major devastation. And yet it killed only 772 people—not enough to be included in our chart. Remember the mosquito-borne zika virus? It generated a flurry of headlines in 2015–2016, focused on dangers to pregnant women. It killed 53 people.

Better the Devil You Know

WHO estimates that "up to 650 thousand people across the globe each year die from respiratory illnesses linked to flu," or .0083 percent of the world's population in a bad flu year.[41] Yet no one panics when it comes to this persistent killer, even in the worst years.

Since actual counting is impractical, the CDC instead estimates the number of symptomatic flu illnesses, hospitalizations, and deaths each year.[42] These estimates come from a model, so they're uncertain. The CDC puts bounds around a central estimate, within which they're 95 percent sure the correct number lies. This number is useful for gauging the quantity of needed medical services.

Figure 6.7 shows the estimated number of symptomatic flu infections for each flu season from 2011 to 2019.[43] As of April 4, 2020, the CDC closed out its preliminary estimates for the 2019–2020 flu season. Their estimate was thirty-one to forty-five million symptomatic illnesses,

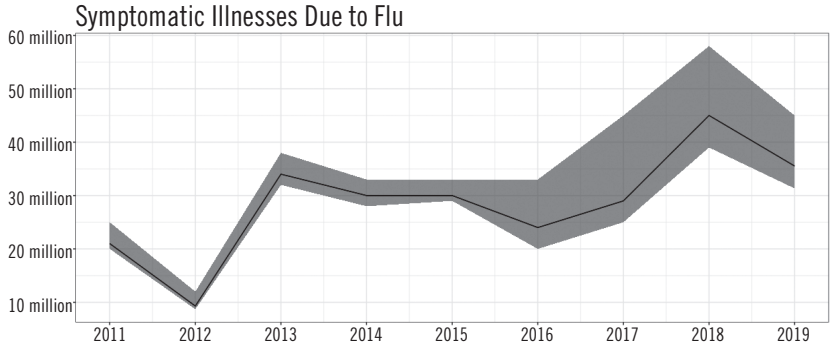


Figure 6.7. Estimated symptomatic flu illnesses in the United States from the 2011–2012 season to the 2019–2020 season. Estimates are plotted at the year when the season started (so the estimate for the 2019–2020 season is placed at 2019).

making this an average year.[44] The 2017–2018 season, in contrast, was a bad year for the flu. The estimate for that year was forty-five million symptomatic illnesses, with anywhere from thirty-nine to fifty-eight million possible. This means that 12 to 18 percent of the country suffered from the flu.

Next, in Figure 6.8, are flu hospitalizations over the same time period. By the end of May 2020, there had been an estimated 410,000–740,000 hospitalizations for the 2019–2020 season. Again, the 2017–2018 year was particularly bad. There were an estimated 810,000 hospitalizations, with the confidence range running from 620,000 to 1.4 million.

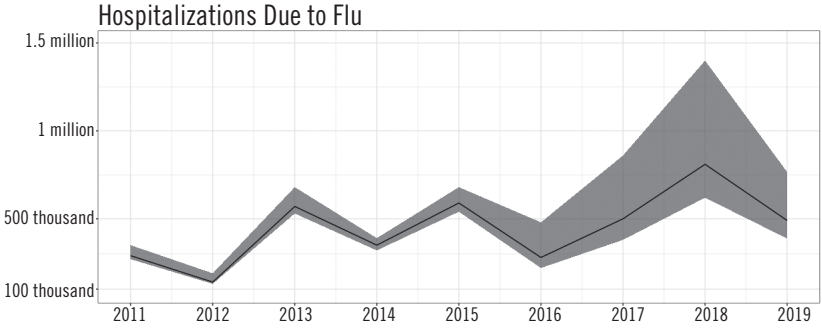


Figure 6.8. Estimated flu-related hospitalizations in the United States from the 2011–2012 season to the 2019–2020 season. Estimates are plotted on the year when the season started (so, the estimate for the 2019–2020 season is placed at 2019).

The flu puts lots of people in the hospital, including previously healthy people. In 2016, one of us (Jay Richards) ended up in the hospital with acute pneumonia and pleural effusion. My chest cavity filled up with sticky fluid, which caused my left lung, in effect, to stick to my ribs. I could barely breathe. As my wife drove me to the emergency room, I heard a choir sing (with no radio on) and was probably just a few hours from death. I spent days in intensive care, enduring procedures that didn't fix the problem. I finally had major surgery, which required the doctors to collapse my lung. I spent another week in the hospital afterwards, with three large tubes inside my chest cavity, and

exiting my left side. The doctor only removed them on the day she discharged me. It took weeks to get off a cocktail of opioids, and months to fully recover. All of this started with a run-of-the-mill cold or flu. I was healthy and in my forties. Just think what the flu can do to old people in poor health!

Figure 6.9 shows the number of deaths attributed to the flu each year in the U.S. The median is about thirty-eight thousand. The estimate for the 2019–2020 season is twenty-four to sixty-two thousand deaths. Once again, the 2017–2018 year was especially bad. The best guess was sixty-one thousand killed (anywhere from forty-six to ninety-five thousand).

The 2019–2020 flu season was average-to-low in terms of deaths, as you can see in Figure 6.10. Flu deaths tend to start around the first of October. They quickly grow, peaking right around, or just after, the new year in bad seasons like 2014–2015 and 2017–2018, or around the beginning of March in average years. By mid-May, the flu is no longer a concern.

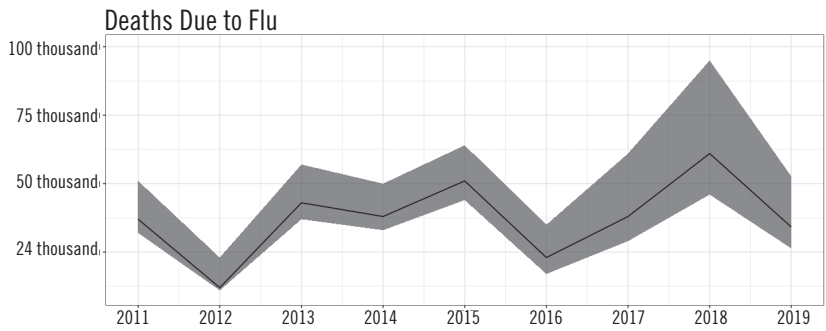


Figure 6.9. Estimated flu-related deaths in the U.S. from the 2011–2012 season to the 2019–2020 season. Estimates are plotted at the year when the season started (thus the estimate for the 2019–2020 season is placed at 2019). Data source: "Pneumonia and Influenza Mortality Surveillance from the National Center for Health Statistics Morality Surveillance System," CDC, https://gis.cdc.gov/grasp/fluview/mortality.html; "NCHSData 14 (5)," CDC, https://www.cdc.gov/flu/weekly/weeklyarchives2019-2020/data/NCHSData15.csv.

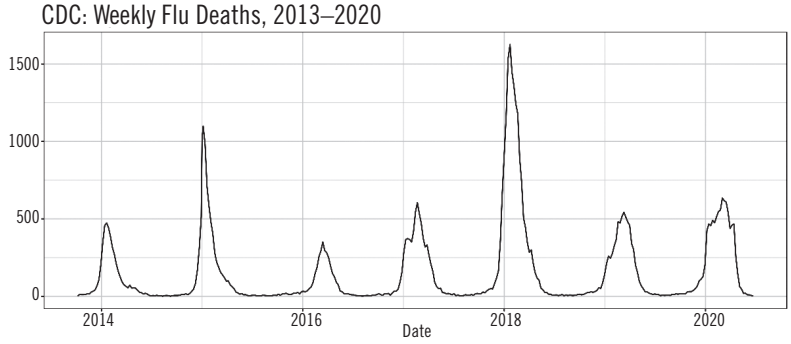


Figure 6.10. Weekly deaths due to flu from 2013 to 2020, as estimated by the CDC.

COVID-19 in Context

COVID-19 will go down in history, but not for the number of deaths it caused, as you can see from Table 6.6 above. All death brings pain, but as far as historic pandemics go, the coronavirus was unremarkable. What was remarkable is how we reacted. The 2009 swine flu pandemic, which killed between 152,000 and 575,000 (as much as 0.009 percent of the world population), caused no panic. By the end of May 2020, COVID-19 might have claimed about as many as the swine flu.

The press covered the swine flu, but there was no worldwide panic. Perhaps it was social media that made the difference. Or perhaps it was the media's very different attitudes toward the occupants in the White House in 2009 and 2020.[45]

There has been a lot of confusion about causes of death among people infected with the coronavirus. Was the virus amplifying pre-existing health problems? That is, was it just one factor among others in hastening death in at-risk groups such as the elderly? If so, then we needed a way to count the extra deaths caused by the virus above those that would have occurred anyway. This was a problem with the data itself, quite apart from forecasts.

Yet even if COVID-19 really caused all the deaths associated with it, the virus won't rank among the deadliest disease agents. Indeed, we knew early on that most who catch it don't even show symptoms.

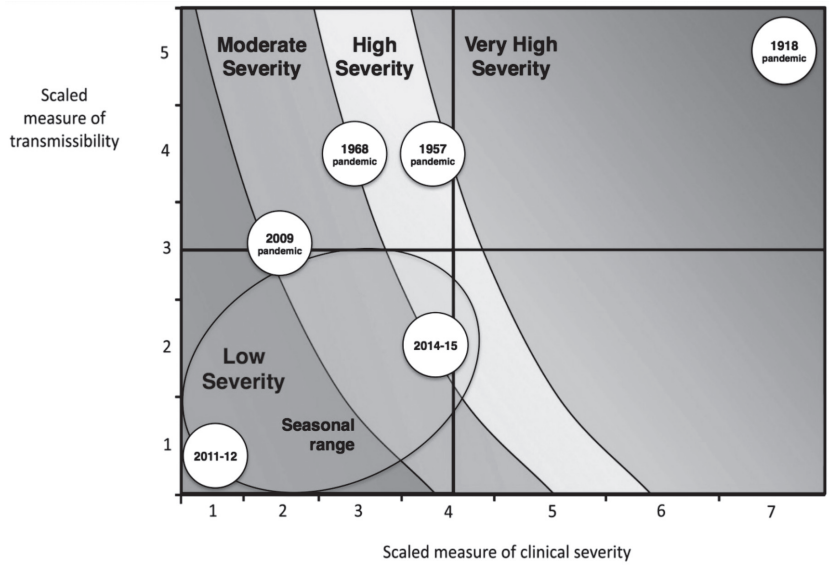


Figure 8.1. The Pandemic Severity Assessment Framework, in chart form, from the *Centers for Disease Control and Prevention* the endnote number).[9]

But few people wanted calm reasoning when the panic set in. Once the pandemic escalated from a medical thing to a political and social thing, the report seemed dull. Instead, WHO, the CDC,[10] and everyone else urged us to be the guinea pigs in a multi-trillion-dollar social experiment that had never been run before, and with precious little evidence in its favor.

What Works?

The WHO report focused on flu transmission. That makes sense, because influenza has been a bigger threat than previous coronaviruses. A Google Scholar search for articles in science and medical journals with the word *influenza* returns 1.4 million hits from 1970 to 2019. Changing the word to *coronavirus* drops the hits by more than 90 percent.

That's okay, though. We want to know how respiratory viruses spread through the population, and the two classes of virus are a lot alike

Before that, the UK had been taking a relaxed approach—like Sweden. If ever there was a flipped policy switch, this was it. So did the lights go out on coronavirus in the UK, or at least dramatically dim?

Not at all. Figure 9.1 shows the daily confirmed coronavirus cases in the UK from the start of March through mid-May. We're using a logarithmic plot here to make it easier to see the exponential growth we talked about in chapter 8. We want to focus not on the numbers but on the shape of the curve. Specifically, the changing *slope* of the curve indicates the changing value of R_e.

We haven't smoothed the data because we want to stick with reported numbers. That means we have to look at the overall path without being distracted by all the jags. When we do that (with the help of the dotted lines) we see a steep upward slope through mid-March, which indicates a value of R_e well above one. But notice that the slope already appears to

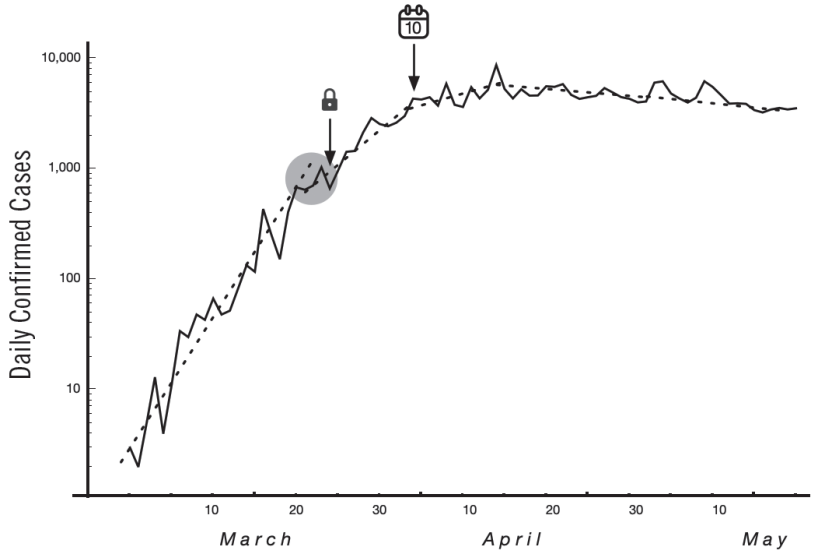


Figure 9.1. Daily confirmed COVID-19 cases in the UK. The lock marks the date of the lockdown. The day-10 calendar shows where cases should have plummeted if the lockdown stopped the spread. Dashed line segments (placed by hand) are a visual aid for seeing the change of slope. The grey circle marks the first visual downward change of slope. Data from https://ourworldindata.org.[11]

the effective meaning of "new cases." At first, it meant sick people who were tested and found to have the virus. By May it mostly meant people with mild or no symptoms who were being tested *en masse* as a way of tracking the pandemic. The far right end of the curve in Figure 9.1 is probably artificially high as a result, though we don't think this affects our conclusions.

There's one more thing that's clear from the UK numbers. As of mid-May, the coronavirus had infected over *two hundred thousand* people in the UK since the lockdown went into effect (taking the lag into account). And that's just the recorded cases. Since about 80 percent of infections cause mild or no symptoms,[13] the vast majority of infected people likely went untested and therefore unrecorded. This means the real number of infections in the UK after lockdown can easily have been over a million.

So the lockdown didn't come close to stopping the spread.

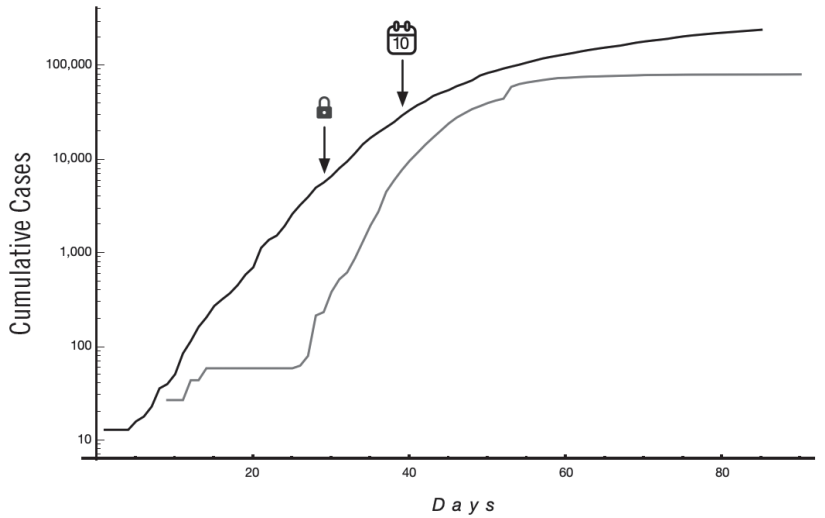
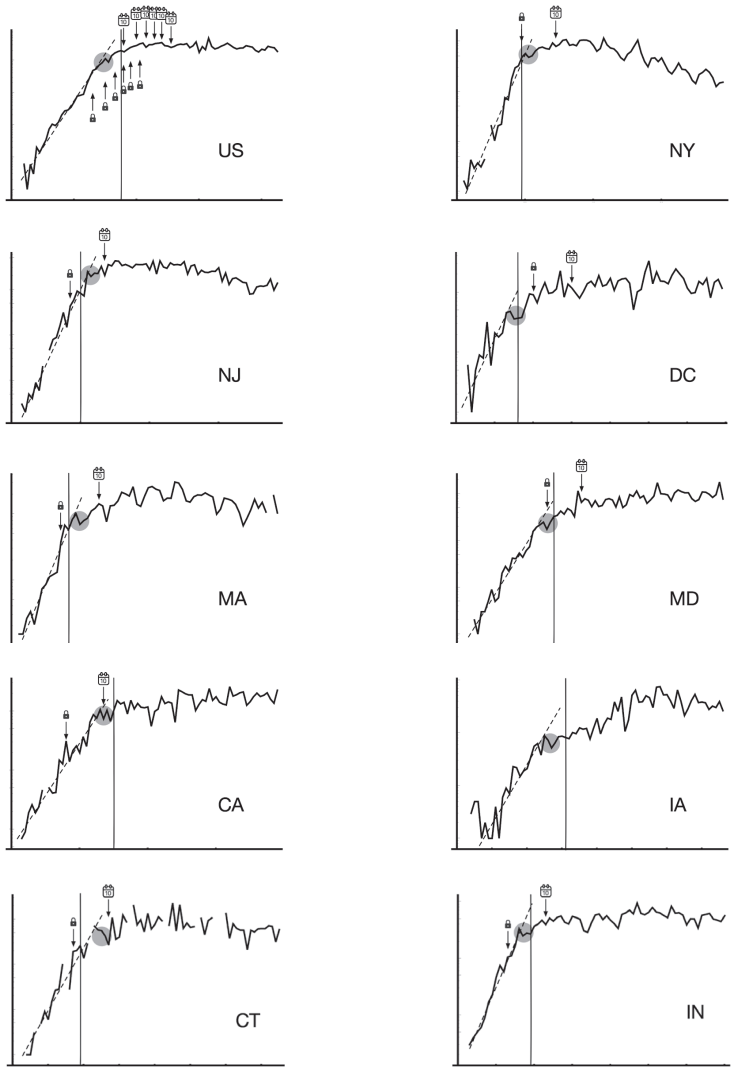


Figure 9.2. Cumulative daily cases in the UK (black line) and China (grey line) over a period of about 80 days. Start and end dates differ for the two countries. (The point of the figure is to compare the visual shapes.)

through June. At the moment, we can only speculate. But if this virus is like others, the causes of the decline are likely some mix of changing seasons and the gradual onset of herd immunity.

The panic and sweeping lockdowns, which did little, were a big mistake.



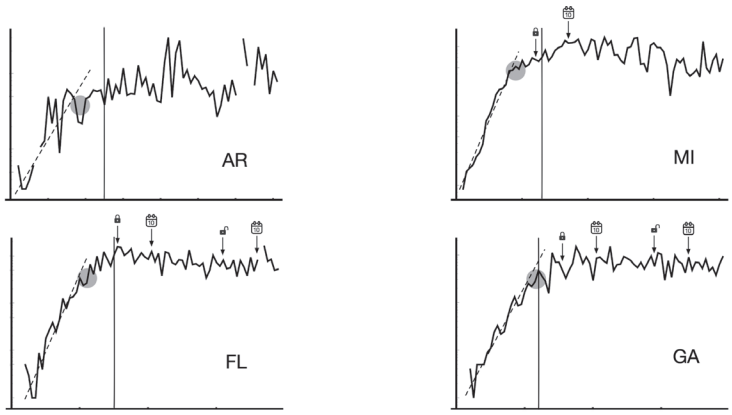


Figure 9.3. Daily confirmed COVID-19 cases for the whole United States and thirteen individual states (logarithmic plots) up to May 20, 2020. Dashed line segments (placed by hand) show the initial steep increase with grey circles marking the first visual downward change of slope. As in Figure 9.1, locks mark the lockdown dates, and ten-day calendars show where lockdowns would have had visible effects. Open locks mark when lockdowns ended for Florida and Georgia, both in the first wave of states to emerge from lockdown. The vertical lines mark the dates when deaths attributed to the coronavirus reached five per million people in the population. Gaps in curves are the result of unreported data. Information sources: https://ourworldindata.org (for U.S. cases); https://covidtracking.com/api (for state cases); https://www.nytimes.com/interactive/2020/us/coronavirus-stay-at-home-order.html (for lockdown dates).[18]

World Tour

We can also examine the effects of lockdowns by looking at different countries.

The United States contains about four percent of the world population. Yet from late April through mid-May, our country claimed to have about a third of the reported coronavirus cases and a quarter to a third of related deaths worldwide. What accounts for these mismatches?

The Philippines, with 107 million people, has a population about a third the size of the U.S. On May 12, 2020, they reported 11,086 cases and 726 deaths, according to Worldometer.[19] This amounts to 104 cases and 7 deaths per million people. On that same day, the

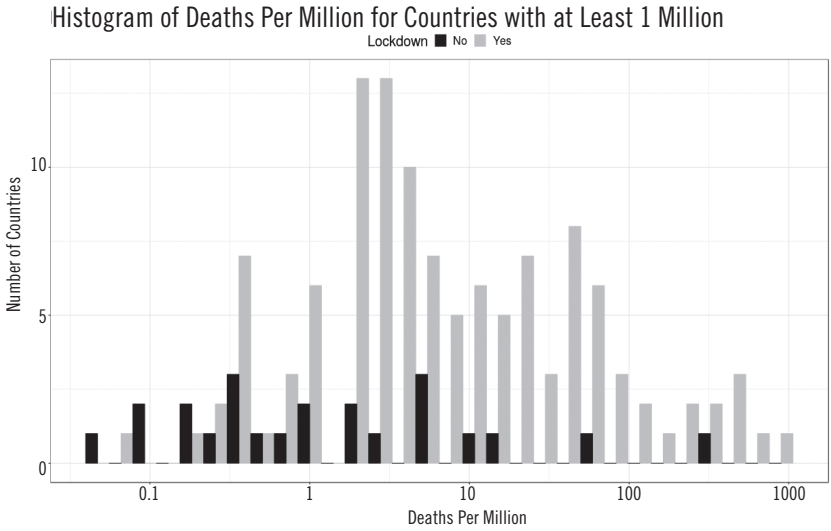


Figure 9.4. A count of countries with various total reported coronavirus deaths per million as of May 12, 2020 (for countries with at least a million people).

Figure 9.4 shows a histogram of the deaths per million for those countries with a population of at least one million, distinguishing countries with lockdowns from those without. The death rates across the different countries are on the horizontal axis. These ranged from zero (for Vietnam) to almost one thousand per million. The bar heights show how many countries had the specified death rate.

The horizontal scale is by log base ten, a necessity because of the huge variability in death rates. Countries that did not have lockdowns are in black; those with lockdowns are grey. If anything, the countries without lockdowns tend to be further to the left. That is, they had lower death rates.

Now, there are so many factors at play here, and not that many countries without lockdowns. So, this evidence doesn't prove that lockdowns didn't work. Rather, it shows how hard it is to show that they did work. And that's a serious problem when we consider the full costs of

shutting economies down. We'll unpack those costs in chapter 10, but as a quick spoiler: they're *brutally high.*

Another way to look at it, since population density may play a role, is a plot of the death rate per million by population size. Again, we limit our graph to countries with at least one million people.

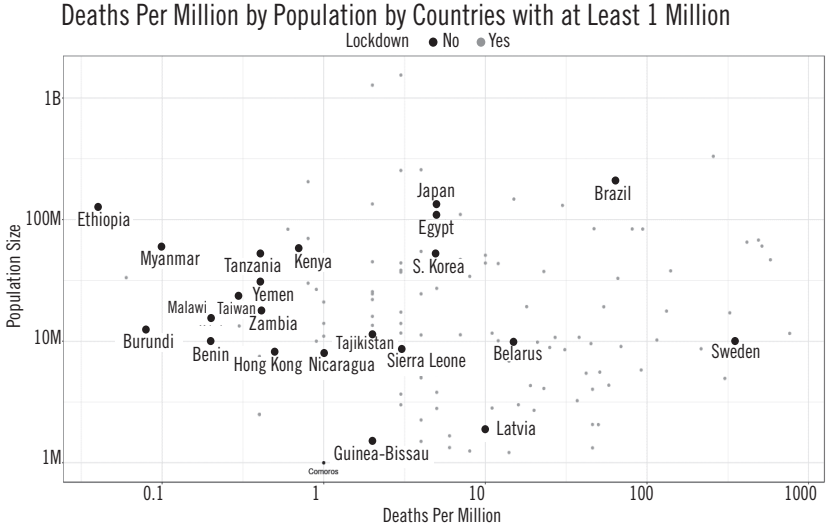


Figure 9.5. Coronavirus deaths per million (long axis) arranged by population (short axis) as of May 12, 2020 (for countries with at least a million people).

Again, countries that remained open are in black, and those that shut down are in grey. The two top population points are, of course, China and India. The countries with the highest death rates were discussed above. Death rates were more than highly variable: they were all over the place![27]

Lockdowns ranged from severe, as in China's Wuhan, to practically non-existent or highly localized, as in Botswana, where major cities saw greater control than the countryside and smaller cities.[28]

If lockdowns had determined the course of the coronavirus, then we would not expect to see such vast variability in the reported death rates across the world. Belgium had 751 deaths per million while Ethiopia,

Are We Already Seeing Excess Deaths from the Lockdown?

We have argued that the lockdowns put in place to save lives from the coronavirus are bound to claim lives by the tens or hundreds of thousands. It may take years for some of these premature deaths—such as those resulting from lost medical care—to take place. But can we already see evidence of some excess deaths?

To answer this question, we first need to know how many deaths were caused by the coronavirus. You'd think we could get reliable numbers for this. After all, these figures were constantly in the headlines. Alas, even the official sources disagree, though the discrepancies are mostly small until we approach the current date. In Figure 10.1 we again see the weekly all-cause deaths. There is some uncertainty at the end of the figure because CDC advises that data can be adjusted up or down, (usually up), as many as eight weeks after the data are published.[64]

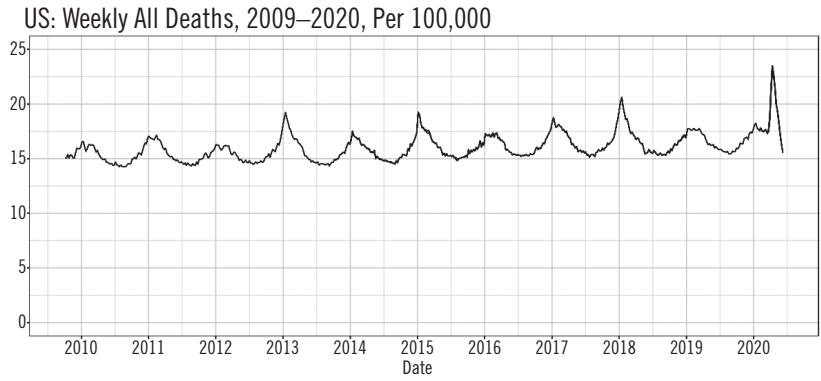


Figure 10.1. The number of people in the U.S. who died per week from all causes, per 100,000, from late 2009 through June 6, 2020. This is data provided by the CDC in three separate official sources. This first is historical and runs from 2009 through the beginning of 2019. The second begins at the end of 2013 and runs through the most current date.[65] The last, a newer data source that also includes the official number of COVID-19 deaths by week, begins in early 2020 and also runs through the most current date.[66] We used U.S. yearly population, estimating it week by week to normalize the plot.[67]

Deaths from all causes peak around January each year because of the flu and associated diseases including pneumonia. The varying height of the January spikes shows that some flu seasons are worse than others. As we saw in chapter 3, the 2017–2018 flu season was particularly brutal.

It's important to note the slow increase in the death rate from year to year. This is most likely due to an increase in the mean age as the huge Boomer generation makes its exit.

The prominent peak starting in March 2020 is due to the coronavirus. Flu-associated deaths, which normally peak in January, were low in this shorter-than-normal flu season, meaning there were fewer flu-associated deaths from pneumonia. This year, the coronavirus may have claimed some lives that a more dangerous flu strain would have claimed.

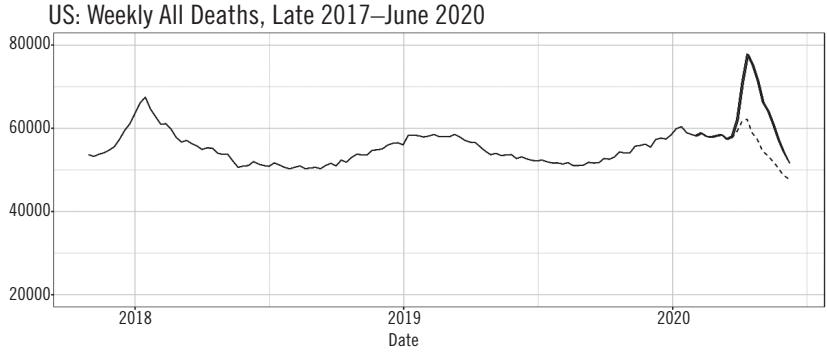


Figure 10.2. All-cause weekly deaths from late 2017 onwards, using two official sources of CDC data. The dashed line is the all-caused death minus the official COVID deaths, using the CDC's COVID death page. The line becomes thicker at the end because of slight discrepancies in the CDC sources.

Figure 10.2 shows the raw death numbers from all CDC sources. The 2017–2018 flu season produced a larger peak than the two flu seasons that followed. The highest peak, following the 2019–2020 flu season, is associated with the coronavirus pandemic. Let's see how closely associated. The dashed line shows all-cause deaths minus the official COVID-19 numbers—in other words, deaths by everything *but* the coronavirus.

In most years, deaths are on the way down by April. In 2020 they peaked a second time in that dashed line. If we accept the official numbers, then these unusual deaths have some other cause. Now it may be that these "extra" deaths are COVID-19 deaths somehow missed by all the people eager to classify deaths as coronavirus—though that seems unlikely. Or they might be genuine non-COVID deaths, as the CDC thinks.[68]

What caused the re-spike in non-COVID deaths? One possible culprit is the lockdowns themselves. Delayed treatment led to at least some deaths. Perhaps being cooped up inside also is harmful in itself. Lockdowns force the healthy and sick into tight quarters, enhancing the spread of all communicable diseases. At least in the United States, the lockdowns threw younger and healthier people out of work and forced them to stay home, sometimes with older, sickly relatives. Both lockdowns and fear forced people inside.

England and Wales had a harsher lockdown than the United States. Several American states never locked down at all, and even in some states with lockdowns, enforcement was not thorough, especially outside cities.

With that in mind, here are the all-caused weekly per capita deaths for England and Wales.

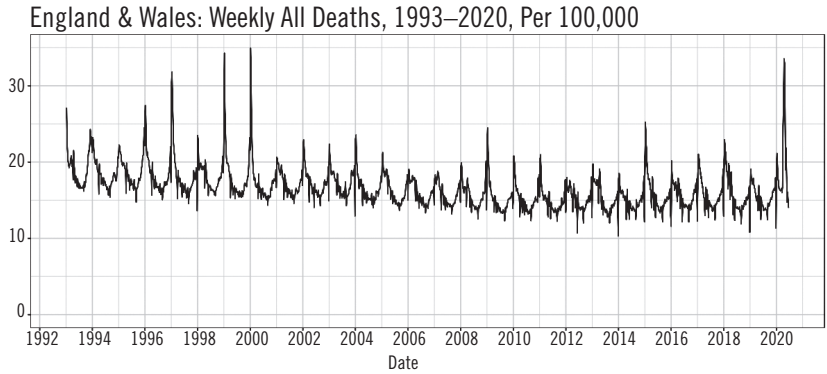


Figure 10.3. The all-cause weekly deaths from England and Wales, from 1993 to May 15, 2020. Office of National Statistics.[69]

It is clear from Figure 10.3 that the 2020 coronavirus peak was not as bad as the 1999–2000 flu year in England and Wales. The coronavirus about tied the 1998–1999 flu season. Remember, there were no lockdowns in those flu years. In Figure 10.4, the dashed line shows the difference between all-cause deaths and official COVID deaths.

Figure 10.4. The number of all-cause weekly deaths in England and Wales from 2017 through June 19, 2020. The dashed line is the all-cause deaths minus the official COVID-19 deaths.

First, in many years there's a dip in reported deaths on or about December 25. Whether this is from people trying to eke out one last Christmas or because the bureaucracy shuts down for a week, we don't know. At any rate, the coronavirus peak in 2020 is obvious.

But so is the dashed line. It's much larger than in the United States, which means that England and Wales had more "extra" deaths from causes other than the coronavirus than we did. Again, we can't prove that lockdowns caused these extra deaths. But the skeptic is under the burden of proving, and not just hoping or assuming, that the coronavirus caused these deaths. This will be tough: after all, officials bent over backwards to attribute even suspected cases to the virus.

We are not the only ones to notice this strange and unexpected spike. A paper published May 13 by the *British Medical Journal* was entitled